LATE CAMBRIAN AGNOSTOID TRILOBITES FROM ARGENTINA

by JOHN H. SHERGOLD, OSVALDO BORDONARO *and* ELADIO LIÑÁN

ABSTRACT. Late Cambrian agnostoid trilobites are described from an *in situ* locality near the base of the El Relincho Formation in Mendoza Province, northwestern Argentina, and from allochthonous blocks in the younger, Ordovician, Empozada and Los Sombreros Formations of Mendoza and neighbouring San Juan Provinces. The faunas of the olistolites fall into three age groups in terms of North American Late Cambrian biochronology: one Trempealeauan and two late Dresbachian assemblages are represented. Species occurring are compared with appropriate taxa from the USA, Canada and Australia. Species of *Lotagnostus* previously described by Rusconi are reassessed on the basis of replicas of the types and the present material.

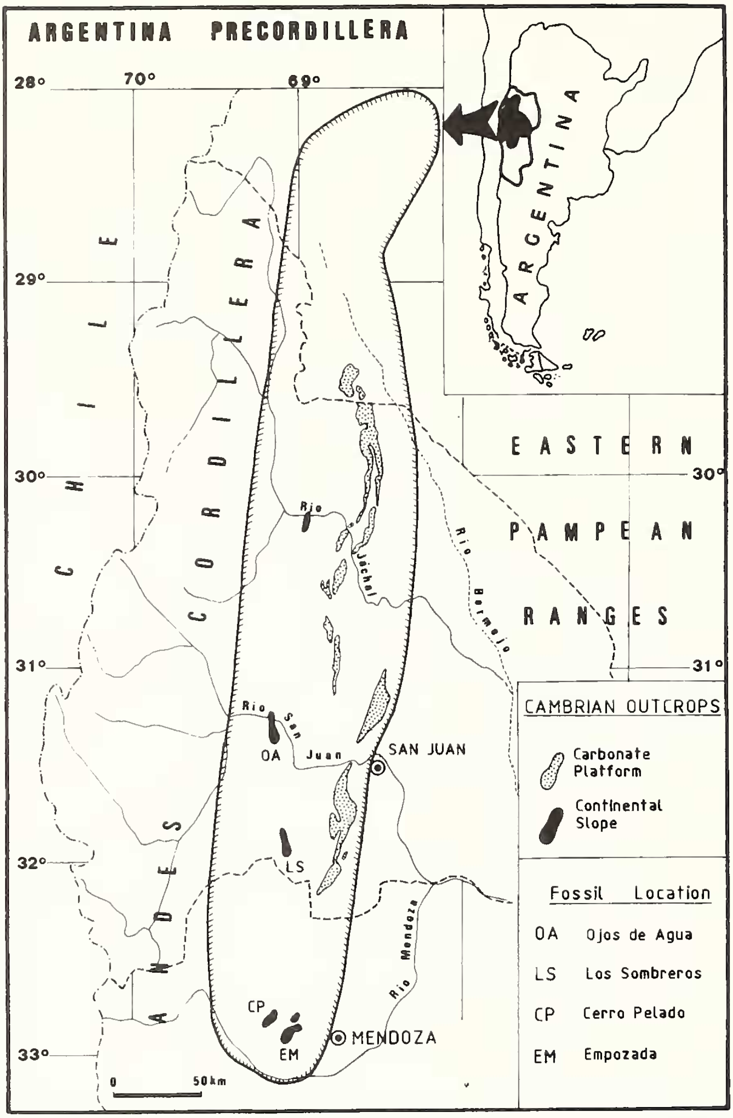
PRECORDILLERAN Argentina is a N–S elongated belt about 500 km in length situated between the Pampeanas Ranges to the east and the Cordillera de los Andes to the west. The region contains a fairly complete sequence of Cambrian rocks which have the most abundant and closely investigated trilobite biofacies in South America. These are distributed in two sedimentary environments: carbonate shelf to the east and continental slope to the west (Text-figs 1–2). Cambrian trilobite biofacies follow this distribution: the endemic species inhabited the restricted carbonate shelf whilst the cosmopolitan species are found in the mixed talus facies interdigitating with the open shelf.

STRATIGRAPHY

The stratigraphy of the Cambrian carbonate shelf facies is well known though the work of Baldis and Bordonaro (1985) who studied a continuous sequence from the Lower Cambrian to Lower Ordovician. Currently, the stratigraphy of Cambrian slope facies is not well known because of abrupt facies changes, chaotic sedimentation and relatively poor palaeontological recovery. Text-figure 2 shows a stratigraphical synthesis of the Precordilleran Cambrian rocks. More data can be found in Bordonaro (1992).

Late Cambrian agnostoid trilobites from the Precordillera of Mendoza Province were studied principally by Rusconi (1948, 1950*a*, 1950*b*, 1951*a*, 1951*b*, 1952, 1953, 1954, 1955*a*, 1955*b*, 1955*c*), but many of his determinations are grossly erroneous. Partly as a result of inadequate illustration, much of his work is difficult to interpret. However, the material is extant and revision is possible, so that misleading biostratigraphical conclusions drawn from it may be corrected. Revised generic assignments have been made by Shergold (1977) and Shergold *et al.* (1990). The objective of the present paper is the description of new material from the classic Mendoza locality and from new localities discovered in Mendoza and San Juan. The agnostoids here described are from the Los Sombreros Formation (San Juan Province), Empozada Formation (Mendoza Province), and El Relincho Formation (Mendoza Province).

The Los Sombreros Formation is a sequence of almost one thousand metres thickness cropping out on the eastern flank of the Tontal Range in the western Precordillera of San Juan. It is composed of a talus association of shale and thinly bedded limestone with olistolites, olistostromes, calcareous breccias and channelled conglomerates. The age is not known precisely, but it was probably deposited during the Ordovician, since it is common to find calcareous olistolites containing

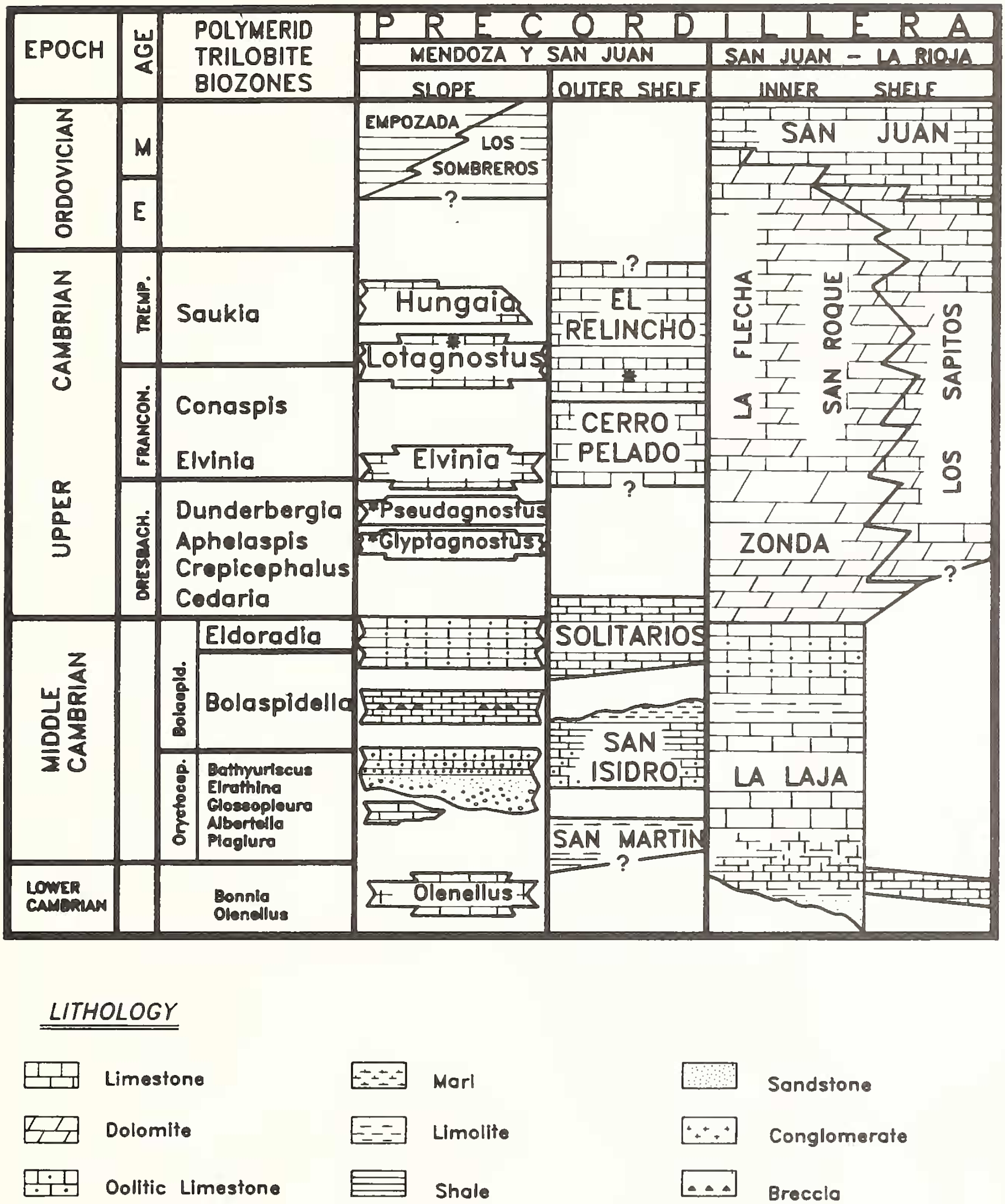


TEXT-FIG. 1. Geographical and geological setting of the Cambrian rocks of Precordilleran Argentina. Material studied here is from localities OA, Ojos de Agua; LS, Los Sombreros; CP, Cerro Pelado; EM, Empozada.

allochthonous Middle and Late Cambrian trilobites, and also autochthonous Early and Middle Ordovician graptolites in dark green shales (Cuerda *et al.* 1983).

The Empozada Formation is about 300 m thick and crops out in the San Isidro area to the west of Mendoza city. It is composed mainly of black shales with abundant calcareous olistolites, breccias and sandstones. It contains allochthonous Late Cambrian trilobites which occur in dispersed calcareous blocks within the lower half of the unit. The age of deposition of the Empozada Formation is at least mid-Ordovician as indicated by the presence of the graptolites *Nemagraptus gracilis* (see Cuerda 1979) and *Glossograptus hincksi*.

The El Relincho Formation is a unit composed mainly of limestone and black shale exposed in Cerro Pelado to the west of Mendoza city. The age of the base of this formation is Late Cambrian



TEXT-FIG. 2. Cambrian stratigraphy of Precordilleran Argentina. In the slope facies of the Los Sombreros Formation, beds containing the names of representative trilobite genera indicate allochthonous blocks. The asterisked names show the biostratigraphical position of the fossils studied against a basically North American timescale.

because conodonts belonging to the *Proconodontus tenuiserratus* Zone have been found (Heredia 1990). The top of the formation is not yet dated.

SYSTEMATIC PALAEONTOLOGY

All material used in this study is identified as the Bordonaro Collection and is deposited in the collections of the Departamento de Paleontologiça Invertebrados, Universidad Nacional de San Juan (PIUNSJ), Argentina. Descriptive terminology follows Harrington *et al.* (1959), with additional terms from Öpik (1967), Shergold (1977), and Shergold *et al.* (1990).

Order AGNOSTIDA Salter, 1864*a*
Superfamily AGNOSTOIDEA M'Coy 1849
Family AGNOSTIDAE, M'Coy, 1849
Subfamily AGNOSTINAE, M'Coy, 1849

Genus LOTAGNOSTUS Whitehouse, 1936
Subgenus LOTAGNOSTUS Whitehouse, 1936

Type species. Agnostus trisectus Salter, 1864*b*, p. 10, by original designation of Whitehouse, 1936, p. 101.

Lotagnostus (*Lotagnostus*) *peladensis* (Rusconi, 1951*a*)

Plate 1, figures 1–9

v1951 *Homagnostus peladensis* Rusconi, 1951*a*, p. 2, text-fig. 1.
v1951 ?*Homagnostus manantialensis* Rusconi, 1951*a*, p. 2, text-fig. 2.
v1951 *Triplagnostus pedrensis* Rusconi, 1951*b*, pl. 7, text-fig. 7.

Material. Many dozens of cephala and pygidia preserved as calcite exoskeletons, external and internal moulds; studied paradigm PIUNSJ 651–662.

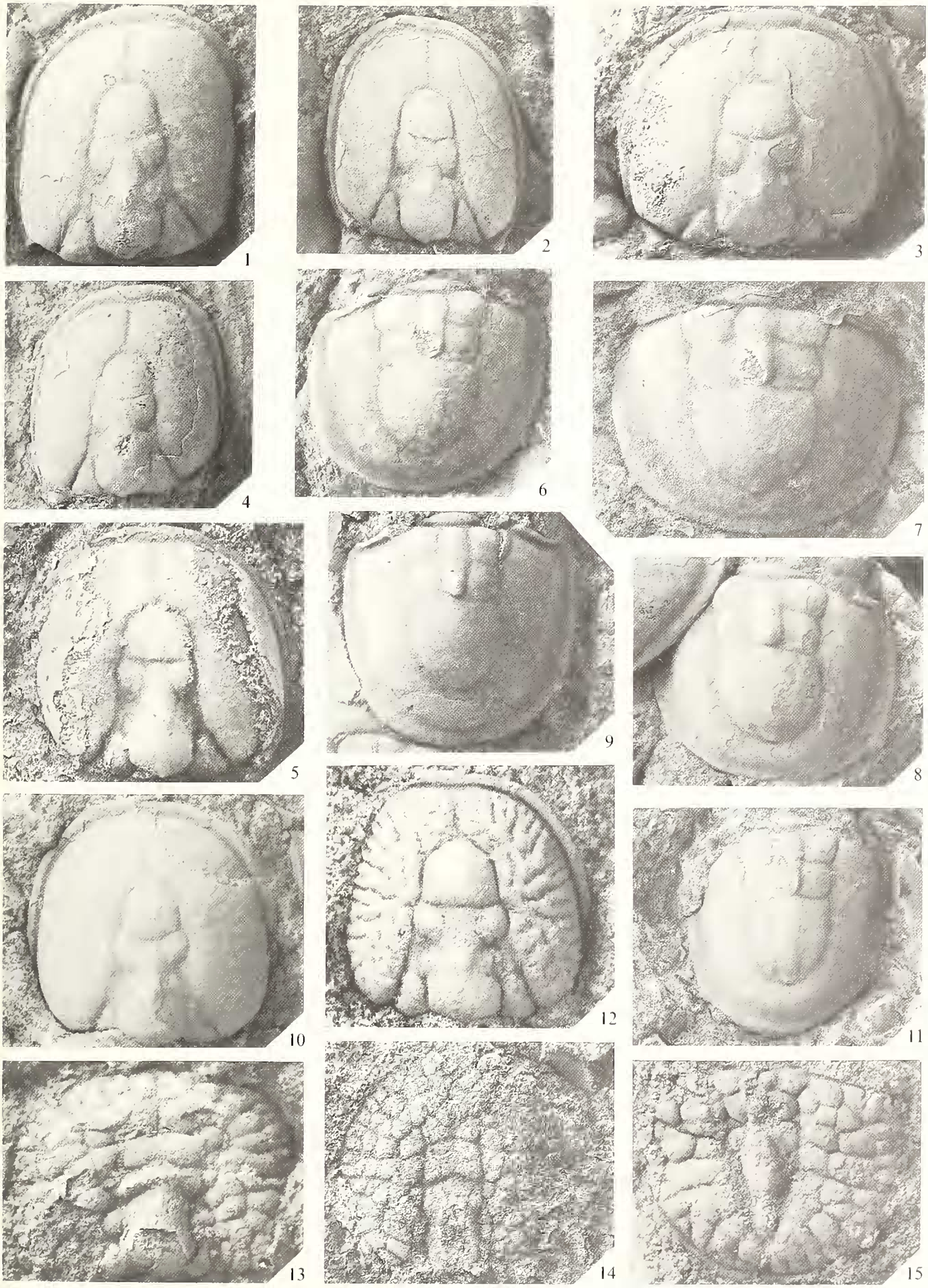
EXPLANATION OF PLATE 1

Figs 1–9. *Lotagnostus* (*Lotagnostus*) *peladensis* (Rusconi, 1951*a*). 1, PIUNSJ 651; cephalon with exoskeleton mostly preserved; locality CP74, El Relincho Formation, Cerro Pelado, Mendoza; ×8. 2, PIUNSJ 652; laterally compressed cephalon, mostly effaced, showing weak scrobiculation; same locality; ×8. 3, PIUNSJ 653; sagittally compressed cephalon, mostly exfoliated; same locality; ×10. 4, PIUNSJ 654; laterally compressed, mostly exfoliated cephalon, same locality; ×8. 5, PIUNSJ 662; mostly exfoliated cephalon; olistolite LC9, Empozada Formation, San Isidro, west of Mendoza; ×8. 6, PIUNSJ 656; pygidium preserved with thin exoskeletal vestige; locality CP74, El Relincho Formation, Cerro Pelado, Mendoza; ×6. 7, PIUNSJ 657; latex replica of sagitally slightly compressed pygidium; same locality; ×6. 8, PIUNSJ 658; pygidium with exoskeleton preserved, same locality; ×6. 9, PIUNSJ 661; pygidium, largely exfoliated with laterally constricted acrolobe; olistolite LC9, Empozada Formation, San Isidro, west of Mendoza; ×10.

Figs 10–11. *Lotagnostus* (*Lotagnostus*) *attenuatus* (Rusconi, 1955*a*). 10, MNH Mendoza 18208B; silicone replica of mostly exfoliated, weakly scrobiculate syntype cephalon; 300 m west of San Isidro, Mendoza; ×8. 11, MNH Mendoza 18208A; silicone replica of exfoliated pygidium showing tripartite posterior lobe and faintly constricted, scrobiculate acrolobe; same locality; ×8.

Fig. 12. *Lotagnostus* (*Lotagnostus*) *trisectus* (Salter, 1864). MNH Mendoza 9973; silicone replica of exfoliated strongly scrobiculate cephalon, the original material of *Goniagnostus verrucosus* Rusconi, 1951*b*; Cerro Pelado, west of Casa de Piedra, Depto de las Heras, Mendoza; ×10.

Figs 13–15. *Glyptagnostus reticulatus* (Angelin, 1851) *sensu lato*. All material from olistolite LST3, Los Sombreros Formation, Tontal Range, San Juan. 13, PIUNSJ 700; latex replica of sagittally compressed, exfoliated cephalon; ×12. 14, PIUNSJ 699; incomplete, exfoliated cephalon; ×8. 15, PIUNSJ 701; obliquely compressed, exfoliated pygidium; ×16.



SHERGOLD *et al.*, *Lotagnostus*, *Glyptagnostus*

Occurrence. Olistolite LC9, Empozada Formation, San Isidro, Mendoza, and locality CP74, at the base of the El Relincho Formation, Cerro Pelado, Mendoza.

Description. Cephalon en grande tenue with non-deliquiate border furrows; acrolobe unconstricted, often very faintly scrobiculate; median preglabellar furrow well-defined; glabella trilobed, with long (sag.) ogival anterior lobe; anterior glabellar furrow well-defined, curved adaxially backwards; anterolateral lobes well-defined, separated by a forward extension of the posterior lobe, constrained posteriorly by prominent lateral furrows at which the glabella is laterally constricted; posterior furrows weakly defined, not transglabellar; posterior lobe elevated, parallel-sided, with angular culmination; axial node placed in anterior half immediately behind the glabellar constriction; basal lobes large, long (exsag.), undivided. Pygidium en grande tenue, quadrangular, with non-deliquiate border furrows; gently constricted, non-scrobiculate acrolobe; axis trilobed, only gently constricted at second lobe; anterior two lobes tricomposite, first axial furrow discontinuous, separated medially by large axial node extending forwards over the two anterior lobes; posterior edges of muscle scar impressions are faintly visible on the second axial lobes of some specimens (Pl. 1, figs 6–7); posterior lobe lanceolate, ending in rounded point and terminal node; minute posterolateral spines situated at level of rear of axis.

Remarks. This species most closely resembles *Lotagnostus* (*Lotagnostus*) *hedini* (Troedsson, 1937) because it is essentially non-scrobiculate while remaining en grande tenue. It cannot be synonymized with that species, however, because the anterolateral glabellar lobes are separated by an extension of the median body of the posterior lobe; the basal lobes are longer (exsag.), and in the pygidium the first axial furrow is medially discontinuous. In this last characteristic, *L.* (*L.*) *peladensis* resembles *L.* (*L.*) *americanus* (Billings, 1860), *L.* (*L.*) *asiaticus* Troedsson, 1937 and *L.* (*L.*) *punctatus* Lu, 1964.

The synonymy suggested above is based on evaluation of silicone replicas obtained from the Rusconi collection by A. R. Palmer and replicated for Shergold in 1972. Other species of *Lotagnostus* are represented in Rusconi's collections but they differ from the specimens noted above in being more highly scrobiculate. For example, specimens attributed to *Goniagnostus atenuatus* [*sic*] Rusconi (1955*c*, p. 28, pl. 2, figs 13–14; herein Pl. 1, figs 10–11), which also has a tripartite posterior axial pygidial lobe, *G. rotundatus* Rusconi (1951*b*, p. 6, text-fig. 6) and *G. verrucosus* Rusconi (1951*b*, p. 5, text-fig. 5, illustrated as a pygidium; herein Pl. 1, fig. 12) which are based on heavily scrobiculate cephala. These specimens so closely resemble *L.* (*L.*) *trisectus* (Salter, 1864*b*) that Shergold *et al.* (1990, fig. 9.7*a*) used the cephalon of *verrucosus* to illustrate the species *trisectus*, thus effectively synonymizing these species (see also Manca 1992, fig. 2).

Age. L. (*L.*) *peladensis* is associated in olistolite LC9 with the olenid trilobite *Mendoparabolina pirquinensis* Rusconi, 1951*a* which seems to be a species of *Bienvillia* Clark, 1924 very close to *B. corax* (Billings, 1865). This is known elsewhere from boulders in the Lévis Formation of Quebec (Billings 1865; Rasetti 1944) and Shallow Bay Formation (Cow Head Group) of western Newfoundland (Rasetti 1954; Fortey *et al.* 1982; Ludvigsen *et al.* 1989), and the Gorge Formation of Vermont. In western Newfoundland, *B. corax* is associated with *Lotagnostus* (*Lotagnostus*) *hedini* and is representative of the *Keithia schucherti* Fauna, of Sunwaptan age, correlated with the *Saukiella serotina* Subzone of the *Saukia* Zone in continental USA (e.g. Oklahoma) (see Ludvigsen *et al.* 1989). Judging from the morphological similarity of the taxa in LC9, a similar age may be assumed.

Genus ONCAGNOSTUS Whitehouse, 1936
Subgenus ONCAGNOSTUS Whitehouse, 1936

Type species. Agnostus hoi Sun, 1924, p. 28; by original designation of Whitehouse 1936, p. 84.

Oncagnostus (*Oncagnostus*) sp.

Plate 3, figures 13–15

Material. The internal and external moulds of a single cephalon, and the external mould of a pygidium, PIUNSJ 678–679.

Occurrence. Olistolite Em O1, Empozada Formation, San Isidro, Mendoza.

Description. Cephalon en grande tenue, with narrow (sag.) borders and deliquiate border furrows, and weakly scrobiculate, unconstricted acrolobe divided sagittally by median preglabellar furrow; glabella proportionately short (sag.), elevated, with weakly ogival anterior lobe differentiated from posteroglabella by strong, continuous, anterior transglabellar furrow; posteroglabella with prominent lateral notches behind anterolateral lobes and adjacent to front of basal lobes as in some species of *Innitagnostus*; condition of glabellar culmination unknown; axial glabellar node at mid-length of posteroglabella; basal lobes more extensive transversely than exsagittally; short posterolateral spines.

Pygidium en grande tenue, with non-deliquiate border furrows and unconstricted, non-scrobiculate acrolobe, lacking a median post-axial furrow; relatively long (sag.) axis, laterally inflated, constricted where the first segmental furrow intersects the axial furrow; first furrow interrupted medially, defining anterolateral ellipsoidal lobules; second axial furrow interrupted medially by prominent, elongate axial node which extends on to front part of posterior lobe; posterior lobe longer (sag.) than anterior two lobes combined, laterally inflated, posteriorly broadly rounded, bearing nodular lines, but poorly defined terminal node; posterolateral spines prominent, retrally sited across the rear of the pygidial axis.

Remarks. Oncagnostus (*Oncagnostus*) was revived by Shergold *et al.* (1990) to include four species previously classified within the closely related *Agnostus* (*Homagnostus*). The pygidia of the subgenera are similar in that they both develop anterolateral lobules on the pygidial axis and accordingly do not have a continuous transaxial anterior furrow. In general, however, species of *Oncagnostus* have deliquiate border furrows in both cephalon and pygidium, have an often long (sag.) and inflated pygidial axis which is broadly rounded posteriorly, and a relatively broader (tr.) glabella. They often lack a median preglabellar furrow, but not in the presently described species, and they frequently have retral posterolateral pygidial spines lying level (tr.) with the posterior end of the pygidial axis. The pygidium of our species resembles *Homagnostus comptus* Palmer (1962, pl. 1, fig. 13), from Nevada, *H. tumidosus* Hall and Whitfield *sensu* Palmer (1968, pl. 7, fig. 8) from Alaska, *Homagnostus* sp. 2 *sensu* Shergold (1982, pl. 5, fig. 12), from western Queensland, and, to some extent, specimens from southern Alberta referred to *Homagnostus obesus* (Belt) by Westrop (1986, pl. 1, figs 1–3). The cephalon is also not unlike that assigned by Palmer (1962, pl. 1, fig. 12) to *H. comptus*, but the North American specimen lacks a median preglabellar furrow. Most similar is the specimen that Öpik (1963, pl. 2, fig. 12) referred to *Innitagnostus* [*Agnostus*] *inexpectans* (Kobayashi) which is comparably en grande tenue, weakly scrobiculate and has an identical glabellar format, including the centrally situated axial glabellar node. Species of *Innitagnostus* seemingly are characterized by an axial node located farther towards the anterior of the posteroglabella, and frequently the anterior glabellar lobe is cleft slightly by the median preglabellar furrow. However, this is not always the case, and the possibility of the Argentinian specimen described here representing *Innitagnostus* rather than *Oncagnostus* cannot be dismissed. More material is required to confirm the present determination.

Age. The species mentioned above are from the late Dresbachian of the USA and equivalent Idamean Stage of Australia. The Nevadan and Australian species occur within the *Glyptagnostus reticulatus* Range Zone, but the Alaskan species is associated with *Acmarhachis acuta* (Kobayashi), and is probably representative of the *Dunderbergia* Zone of the Great Basin. The Albertan specimens are slightly younger, occurring in the *Irvingella major* Subzone of the *Elvinia* Zone.

Genus TRILOBAGNOSTUS Harrington, 1938

Type species. Agnostus innocens Clark, 1923, p. 122; by original designation of Harrington, 1938, p. 148.

Trilobagnostus? sp.

Plate 2, figures 1–9

Material. Thirteen cephala and seven pygidia preserved as calcite exoskeletons, PIUNSJ 663–677.

Occurrence. Olistolite Em O2, Empozada Formation, San Isidro, Mendoza.

Description. Subrectangular cephalon, strongly convex, narrow, non-deliquiate border furrow; unconstricted acrolobe, non-scrobiculate; lacking median preglabellar furrow; glabella essentially bilobed, short, with subsphaerical frontal lobe; anterior glabellar furrow well defined and weakly curved backward; posterior lobe convex, unfurrowed, with broadly rounded culmination; axial node subcentral; small basal lobes.

Pygidium subrectangular, degree of deliquiation of border furrow depending on preservation, internal moulds being deliquiate but external moulds being non-deliquiate; narrow borders; unconstricted, non-scrobiculate acrolobe, lacking median post-axial furrow; moderately long axis (sag.), tapering rearwards, posteriorly rounded; anterolateral lobes well defined, as in *Oncagnostus* (*Oncagnostus*) delimited by furrows that are curved forward, not transaxial; second furrow interrupted medially by prominent axial node lapping on to the front of the posterior lobe which narrows rearwards, failing to extend to the posterior border furrow; insignificant terminal node; stout, incurved posterolateral spines retrally sited to the rear of the termination of the axis.

Remarks. Material from Em O2 is compared with the type species of *Trilobagnostus* which has recently been refigured as *Micragnostus innocens* (Clark, 1923) by Ludvigsen *et al.* (1989, p. 12, pl. 1, fig. 25). These authors remark on the length of the pygidial axis and the nature of its anterolateral furrows, and illustrate a similar border furrow and retral posterolateral spines to those described here. Also very similar are the specimens from Jilin Province, China, which Qian (1986, p. 263, pl. 67, figs 1–7) placed in *Geragnostus* (*Micragnostus*) cf. *subobesus* (Kobayashi, 1936), but these are likely to be slightly younger. Shergold *et al.* (1990) noted the apparent similarity of *Trilobagnostus* to the subgenera of *Oncagnostus* as conceived by them (*Oncagnostus*, *Kymagnostus* and *Strictagnostus*) and suggested that it could form a fourth subgenus. There is also great similarity to species of *Eurudagnostus*, especially *E. brevispinus* Lermontova (1951, pl. 2, figs 5–6, *non* fig. 7) and *Rudagnostus*, which is reflected in the synonymies proposed by Shergold *et al.*, i.e. *Eurudagnostus* [= *Oncagnostus*] and *Rudagnostus* [= *Trilobagnostus*]. However, all the taxa involved require thorough revision and reassessment beyond the scope of this paper. Our present uncertainty is expressed in the question mark and open nomenclature.

Age. The type specimen of *Trilobagnostus innocens* (Clark) is associated with a species of *Lotagnostus* of the *hedini* group. Thus a Late Cambrian, *Saukia* Zone, age is probable for it. By inference, *Trilobagnostus*? sp. may have a similar age, possibly the same as *Lotagnostus* (*Lotagnostus*) *peladensis* (Rusconi).

Subfamily GLYPTAGNOSTINAE Whitehouse, 1936

Genus GLYPTAGNOSTUS Whitehouse, 1936

Type species. Glyptagnostus toreuma Whitehouse, 1936, p. 101 [= *Agnostus reticulatus* Angelin, 1851, p. 8].

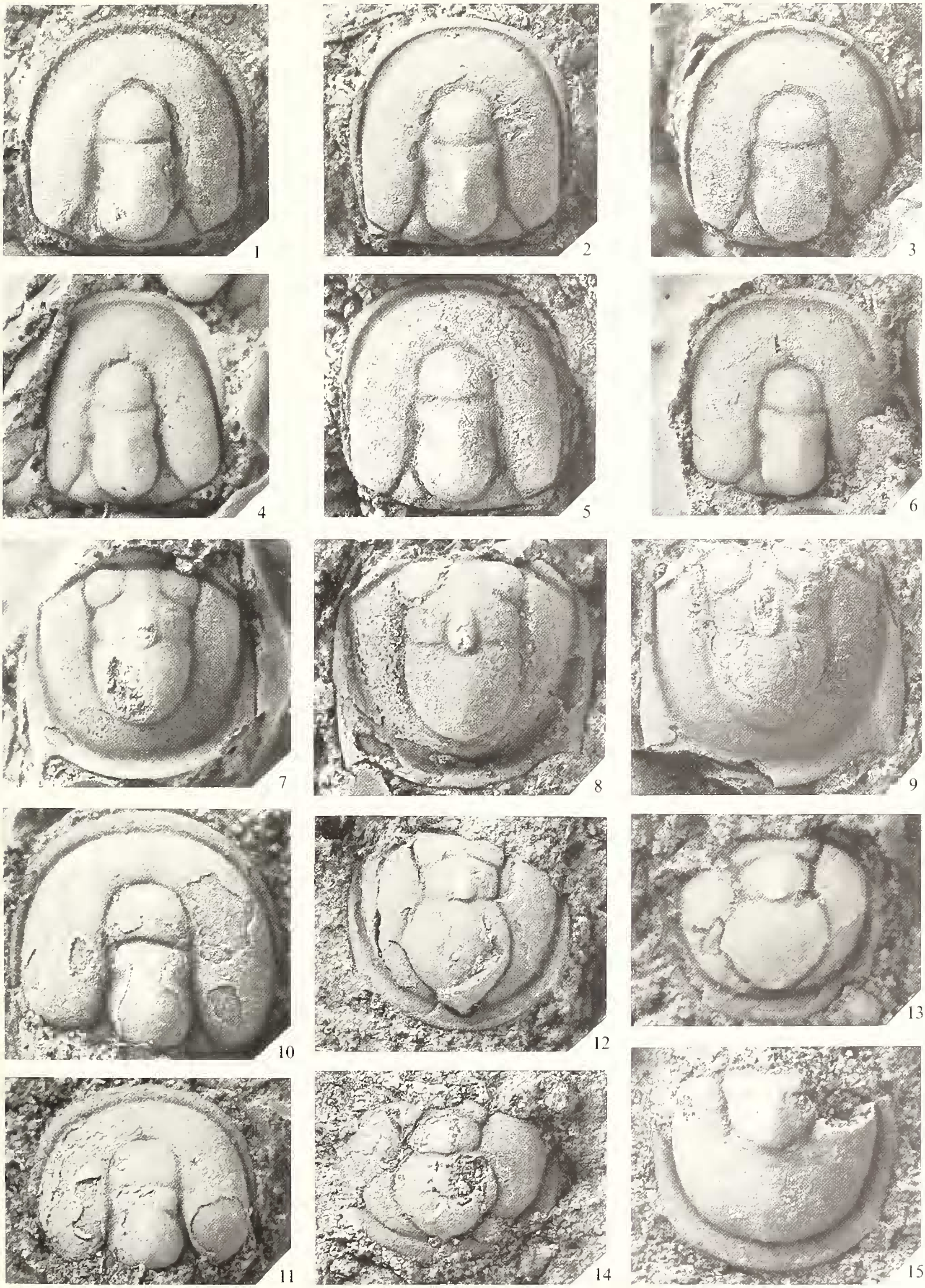
EXPLANATION OF PLATE 2

Figs 1–9. *Trilobagnostus*? sp. All material from olistolite Em O2, Empozada Formation, San Isidro, west of Mendoza. 1, PIUNSJ 663; cephalic exoskeleton; ×14. 2, PIUNSJ 664; cephalic exoskeleton; ×14. 3, PIUNSJ 665; cephalon with most of exoskeleton preserved; ×10. 4, PIUNSJ 666; latex replica of cephalic exoskeleton; ×12. 5, PIUNSJ 667; latex replica of cephalic exoskeleton; ×14. 6, PIUNSJ 668; latex replica of cephalic exoskeleton; ×12. 7, PIUNSJ 674; latex replica of pygidial internal mould; ×14. 8, PIUNSJ 675; pygidium with exoskeleton largely preserved; ×14. 9, PIUNSJ 676; partly exfoliated pygidium; ×12.

Figs 10–14. *Acmarhachis* sp. cf. *A. acuta* (Kobayashi, 1938, *sensu* Rasetti, 1961). All material from olistolite OA2, Los Sombreros Formation, San Juan. 10, PIUNSJ 694a; partly exfoliated cephalon; ×24. 11, PIUNSJ 695; partly exfoliated cephalon; ×16. 12, PIUNSJ 696; largely exfoliated pygidium; ×12. 13, PIUNSJ 697; partly exfoliated pygidium; ×20. 14, PIUNSJ 698; incomplete pygidial exoskeleton; ×16.

Fig. 15. *Neoagnostus* (*Neoagnostus*) sp., PIUNSJ 703; internal mould of small pygidium; locality CP74, El Relincho Formation, Cerro Pelado, Mendoza; ×20.

PLATE 2



SHERGOLD *et al.*, agnostoid trilobites

Glyptagnostus reticulatus (Angelin, 1851) *sensu lato*

Plate 1, figures 13–15

Material. Three cephala and two pygidia preserved as external moulds, PIUNSJ 699–702.

Occurrence. Olistolite T3, Los Sombreros Formation, Sierra del Tontal, San Juan.

Remarks. Although very poorly preserved, this material has the typical characteristics of *Glyptagnostus reticulatus* (Angelin), and, eventually, when more material is available it may be possible to refer it to the subspecies *reticulatus reticulatus*. The material illustrated here is the first record of this cosmopolitan species in South America. Essentially comparable material occurs in Australia (Shergold 1982) and the Ellsworth Mountains of West Antarctica (Shergold and Webers 1992).

Age. All material is representative of the *Glyptagnostus reticulatus* Zone, recognized worldwide (see references in Shergold 1982).

Subfamily INCERTAE SEDIS

Genus ACMARHACHIS Resser, 1938

Type species. Acmarhachis typicalis Resser, 1938, p. 47, by original designation.

Acmarhachis cf. *A. acuta* (Kobayashi, 1938) *sensu* Rasetti, 1961

Plate 2, figures 10–14

cf.1961 *Acmarhachis acuta* (Kobayashi); Rasetti, p. 109, pl. 23, figs 1–8 (see Pratt, 1992, p. 39 for synonymies).

Material. Thirteen cephala and nine pygidia preserved as external moulds and exoskeletons; studied paradigm PIUNSJ 694–698.

Occurrence. Olistostrome level OA2, Los Sombreros Formation, Sierra del Tontal, San Juan.

Description. Cephalic border narrow, gently convex; border furrow subdeliquiate, narrow and deep; acrolobe smooth, unconstricted, lacking median preglabellar furrow, although some specimens have an incipient furrow in front of the glabella. Glabella long and narrow, with elongate, semicircular anterior lobe; anterior glabellar furrow deep, gently arched forwards; anterolateral furrow shallow and chevronate; the posterior lobe is tumid with elevated culmination, laterally constricted where the chevronate anterolateral furrow intersects the axial furrow; axial glabellar node subcentral on the posterior lobe. Pygidium subrectangular, border narrow and uniform, with diminutive, advanced posterolateral spines; border furrow subdeliquiate, shallow; acrolobe unconstricted; axis long and posteriorly ogival; second axial segment subpentagonal and laterally constricted, with a large, prominent axial node; the posterior lobe is lanceolate, its tapered posterior end bearing a terminal node which touches the border furrow. In very small specimens, the posterior lobe is more rounded.

Remarks. Acmarhachis was reappraised by Pratt (1992, p. 38), who considered it to represent a pseudagnostine genus. However, for reasons earlier explained (Shergold 1982; Shergold *et al.* 1990), we prefer to retain *Acmarhachis* within the Agnostidae. Pratt also listed previously described species, grouping most into the American species *A. typicalis* and *A. acuta*. Among the species that he documented, the Argentinian material most closely resembles the former in terms of the diagnostic characteristics of the first segment of the pygidial axis, being laterally undivided. In North America, *A. typicalis* has been described from the North West Territories of Canada (Kobayashi 1938; Pratt 1992), Nevada (Palmer 1962), and Alabama (Resser 1938), where it has an early Dresbachian, *Crepicephalus* Zone, age. However, in terms of furrowing, axial proportions and shape, the Argentinian species clearly most resembles that from Maryland, described by Rasetti (1961) as *Acmarhachis acutus* (Kobayashi, 1938), of late Dresbachian, *Dunderbergia* Zone, age. The

Argentinian species differs from the youngest species so far documented, *A. hybrida* (Shergold, 1980, p. 20, pl. 11. figs 1–6), from western Queensland, in the position of the axial glabellar node. This lies farther forward in the Australian species, which is further distinguished by the presence of a faint median preglabellar furrow.

Age. Acmarhachis acuta (Kobayashi) reportedly has a long range from late in the Middle Cambrian through to the early part of the Late Cambrian in North America, Siberia, Kazakhstan, south-central China and northern and southeastern Australia. The Argentinian species appears most likely to date from the later part of this range.

Family DIPLAGNOSTIDAE Whitehouse, 1936 emend. Öpik, 1967
Subfamily PSEUDAGNOSTINAE Whitehouse, 1936

Genus PSEUDAGNOSTUS Jaekel, 1909
Subgenus PSEUDAGNOSTUS Jaekel, 1909

Type species. Agnostus cyclopyge Tullberg, 1880, p. 26, by original designation of Jaekel 1909, p. 400.

Pseudagnostus (*Pseudagnostus*) *idalis idalis* Öpik, 1967

Plate 3, figures 1–6

1982 *Pseudagnostus* (*Pseudagnostus*) *idalis idalis* Öpik, 1967; Shergold, p. 26, pl. 2, figs 1–13 [with synonymy].

Material. Six cephala and two pygidia, preserved as calcitic internal moulds and exoskeletons, PIUNSJ 680–685.

Occurrence. Olistolite Em O1, Empozada Formation, San Isidro, Mendoza.

Description. Cephalon en grande tenue, strongly deliquiate, with unconstricted acrolobe; preglabellar median furrow deeply incised, widening forward; spectaculate, anterior glabellar furrow being gently curved backward. Pygidium en grande tenue, strongly deliquiate, with gently constricted acrolobe, plethoid and ampullate deuterolobe; retral posterolateral spines sited a little forward of a transverse line drawn across the rear of the deuterolobe.

Age. According to Shergold (1982), this taxon characterizes the Late Cambrian, Idamean, zones of *Glyptagnostus reticulatus*, *Proceratopyge cryptica* and *Stigmatoa diloma* in the Georgina Basin, western Queensland, Australia.

Pseudagnostus (*Pseudagnostus*) *idalis* Öpik, 1967 *sensu lato*

Plate 3, figures 7–12

Material. Eight cephala and twelve pygidia preserved as external moulds and exoskeletons, PIUNSJ 686–693.

Occurrence. Olistostrome level OA2, Los Sombreros Formation, Sierra del Tontal, San Juan.

Remarks. The Pseudagnostidae from the Los Sombreros Formation have morphologies referable to *Pseudagnostus* (*P.*) *idalis* Öpik *sensu lato* according to the classification of Shergold (1977). In general, the exoskeleton shows a higher degree of effacement than *Ps.* (*Ps.*) *idalis idalis* as described above. However, it cannot be assigned to any known subspecies because of differences in preservation. This taxon differs from *Ps.* (*Ps.*) *idalis s. l.* of Shergold (1982, pl. 2, figs 14–15) because its cephalon has substantially less deliquiate border furrows and better defined anterolateral glabellar lobes. Pygidia may be essentially similar, but their varying modes of preservation prevent detailed comparison. Preservation also prevents adequate comparison with *Ps.* (*Ps.*) *idalis denisonensis* Jago (1987, p. 210, pl. 24, figs 4–12) from southwestern Tasmania, and *Pseudagnostus* spp. described by Jell *et al.* (1991, p. 463, figs 4–5) from western Tasmania, although the former shares with the Argentinian taxon a similar, subcentrally positioned, axial glabellar node. Also similar, on some specimens of *Ps.* (*Ps.*) *idalis s.l.*, is the sagittally elongated deuterolobe, which may have a central depression. Such features, however, may be related to preservation. Both of the Tasmanian occurrences are slightly younger than the Idamean as defined by Shergold (1982, 1989, 1993). Specimens with similar morphologies from western Zhejiang Province, China, described by Lu and Lin (1989, p. 232, pl. 14, figs 1–4), are also assigned to *Pseudagnostus* (*Ps.*) *idalis* Öpik. These occur in the *Proceratopyge fenghwangensis* Zone, which correlates with the late Idamean of Australia.

Genus NEOAGNOSTUS Kobayashi, 1955
Subgenus NEOAGNOSTUS Kobayashi, 1955

Type species. Neoagnostus aspidoides Kobayashi, 1955, p. 473, by original designation.

Neoagnostus (*Neoagnostus*) sp.

Material. A single small pygidium measuring (Lp2) 1·9 mm, PIUNSJ 703.

Occurrence. Locality CP74, autochthonous El Relincho Formation, Cerro Pelado, Mendoza Province.

Description. Pygidium with comparatively wide (tr, sag.) borders, non-deliquiate border furrows and minute posterolateral spines; rounded and laterally unconstricted acrolobe; axis with effaced anterior transaxial furrow, axial node situated across (sag.) second lobe, defined only posteriorly; effaced accessory furrows; deuterolobe short (sag.), barely defined but with terminal axial node indicated.

Remarks. The combination of extremely small posterolateral spines, subcircular acrolobe and short (sag.) deuterolobe permit comparison with previously described material from China, Australia and North America (Vermont). *Neoagnostus* (*N.*) *longicollis* (Kobayashi, 1966) *sensu* Zhou and Zhang (1985, p. 68, e.g. pl. 27, fig. 7), from northern Shanxi and southern Jilin, is essentially similar except that it possesses a third pair of axial lobules. *N.* (*N.*) *araneavelatus* (Shaw, 1951, especially pl. 24, fig. 15) from Vermont, and *N.* (*N.*) *orbiculatus* (Shergold, 1975, particularly pl. 12, fig. 10) from western Queensland, Australia, have more circular acrolobes. *N.* (*N.*) *quasibilobus* (Shergold, 1975, see pl. 12, figs 5–7), also from western Queensland, has the most similar acrolobe morphology, but seems to have more prominent posterolateral spines. All of these species have virtually effaced anteroaxes and imperceptible deuterolobes. All similarly occur in the latest Cambrian: Fengshanian, *Mictosaukia orientalis* Assemblage Zone in Shanxi and *Changia* Assemblage Zone of Jilin in China; Payntonian, *Neoagnostus* (*N.*) *quasibilobus*/*Shergoldia nomas* Assemblage Zone in western Queensland; and their equivalents in Vermont.

EXPLANATION OF PLATE 3

Figs 1–6. *Pseudagnostus* (*Pseudagnostus*) *idalis idalis* Öpik, 1967. All material from olistolite Em O1, Empozada Formation, San Isidro, west of Mendoza. 1, PIUNSJ 680; internal mould of cephalon; ×10. 2, PIUNSJ 681; latex replica of mostly exfoliated cephalon; ×10. 3, PIUNSJ 682; latex replica of cephalic internal mould; ×10. 4, PIUNSJ 683b; latex replica of cephalic internal mould; ×10. 5, PIUNSJ 685; latex replica of largely exfoliated pygidium; ×12. 6, PIUNSJ 684; internal mould of pygidium; ×10.

Figs 7–12. *Pseudagnostus* (*Pseudagnostus*) sp. cf. *P. idalis* Opik, 1967 *sensu lato*. All material from olistolite OA2, Los Sombreros Formation, San Juan. 7, PIUNSJ 686; mostly exfoliated cephalon; ×16. 8, PIUNSJ 687; small cephalic internal mould; ×20. 9, PIUNSJ 688; mostly exfoliated cephalon; ×16. 10, PIUNSJ 689; early holaspid pygidium showing initial development of deuterolobe; ×24. 11, PIUNSJ 690; internal mould of early holaspid pygidium with fully developed deuterolobe; ×16. 12, PIUNSJ 691; internal mould of late holaspid pygidium; ×16.

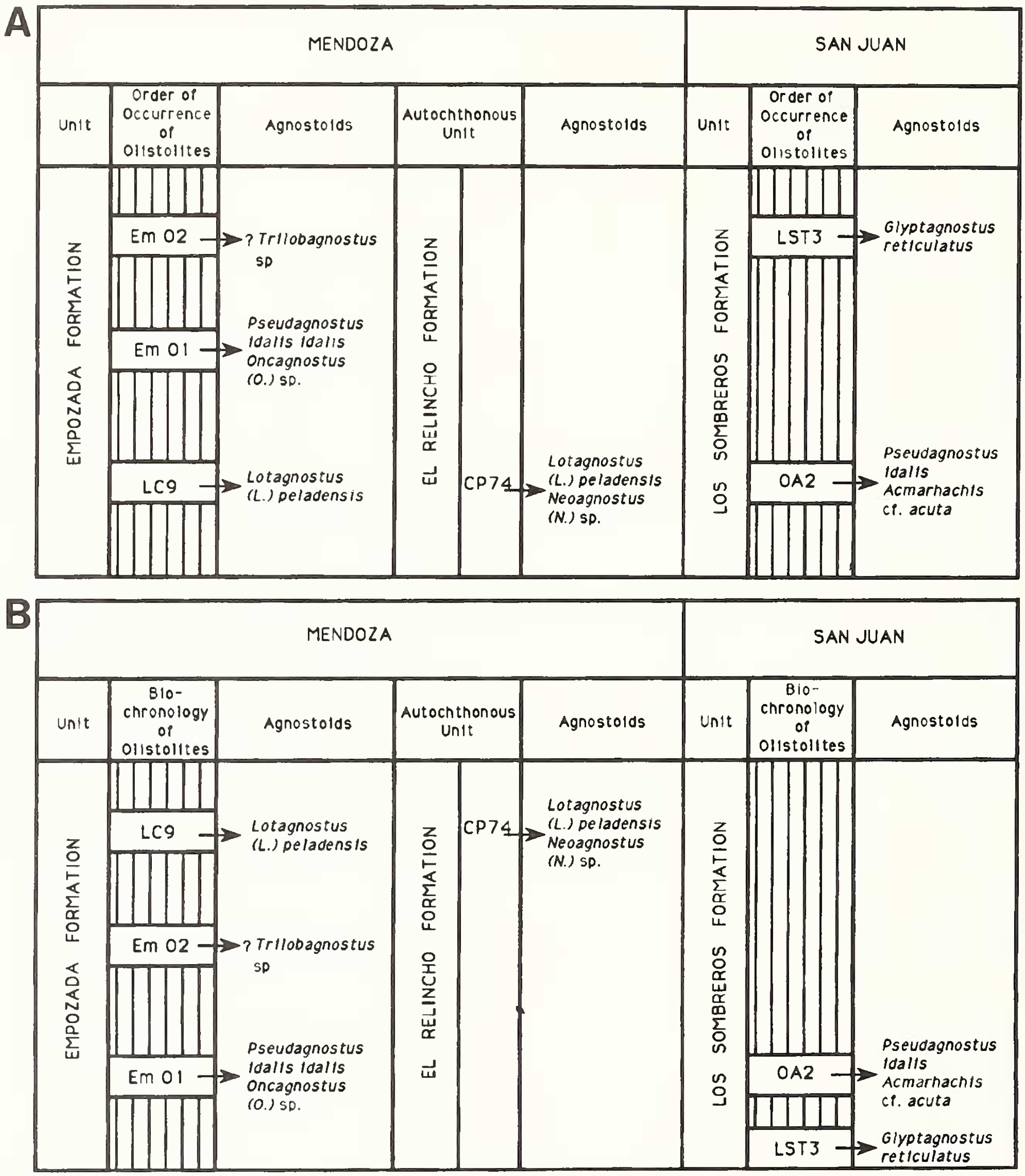
Figs 13–15. *Oncagnostus* (*Oncagnostus*) sp. All material from olistolite Em O1, Empozada Formation, San Isidro, west of Mendoza. 13, PIUNSJ 678b; latex replica of partly exfoliated, weakly scrobiculate cephalon; ×16. 14, PIUNSJ 678a; counterpart of fig. 13, cephalic exoskeleton; ×16. 15, PIUNSJ 679; latex replica of exfoliated pygidium; ×14.

PLATE 3

SHERGOLD *et al.*, *Pseudagnostus*, *Oncagnostus*

SUMMARY

Late Cambrian agnostoids have been obtained from the autochthonous El Relincho Formation, and from five olistolites in the Empozada and Los Sombreros Formations (Text-fig. 3). Agnostoids



TEXT-FIG. 3. A, Stratigraphical distribution of the olistolites in the Empozada and Los Sombreros Formations; B, their inferred biochronological order. Note that the fauna recorded from the El Relincho Formation at Cerro Pelado is autochthonous, and also the youngest of the faunas described.

identified from them include: CP74, *Lotagnostus* (*Lotagnostus*) *peladensis* (Rusconi), *Neoagnostus* (*Neoagnostus*) sp.; LC9, *Lotagnostus* (*Lotagnostus*) *peladensis* (Rusconi); Em O2, *Trilobagnostus*? sp.; Em O1, *Oncagnostus* (*Oncagnostus*) sp., *Pseudagnostus* (*Ps.*) *idalis idalis* Öpik; OA2, *Acmarhachis* cf. *A. acuta* (Kobayahsi), *Pseudagnostus* (*Ps.*) *idalis* Öpik *sensu lato*; LST3, *Glyptagnostus reticulatus* (Angelin) *sensu lato*. They fall into three zonal groups. In North American terms LC9, CP74 and Em O2 represent the late Dresbachian *Dunderbergia* Zone of the USA, equivalent to the late Idamean *Stigmatoa diloma* Zone of Australia, and correlating with the late Steptoean *Parabolinoides calvilimbatus* Zone of northwestern Canada; LST3 represents the late Dresbachian, early *Aphelaspis* Zone of the USA, early *Glyptagnostus reticulatus* Zone of both Canada and Australia.

REFERENCES

ANGELIN, N. P. 1851. *Palaeontologica Scandinavica*: Academiae Regiae Scientarium Suecanae (Holmiae); *Pars 1, Crustacea formationis transitionis*, 1–24, pls 1–24.

BALDIS, B. and BORDONARO, O. 1985. Variaciones de facies en la cuenca cámbrica de la Precordillera Argentina, y su relación con la génesis del borde continental. *Sexto Congreso Latino-Americano de Geología*, Bogotá, Colombia, **1**, 149–161.

BILLINGS, E. 1860. On some new species of fossils from the limestone near Point Levis opposite Quebec. *Canadian Naturalist*, **5**, 301–324.

—— 1865. *Palaeozoic Fossils, 1. Containing descriptions and figures of new or little known organic remains from the Silurian rocks*. Geological Survey of Canada, Montreal, 326 pp.

BORDONARO, O. 1992. El Cámbrico de Sudamérica. 69–84. *In* GUTIÉRREZ-MARCO, J. C., SAAVEDRA, J. and RÁBANO, I. (eds). *Paleozoico inferior de Ibero-América*. Imprime Gráficas Topacio, S.A., Madrid, 630 pp.

CLARK, T. H. 1923. A group of new species of *Agnostus* from Levis, Quebec. *Canadian Field Naturalist*, **37**, 121–125.

—— 1924. The paleontology of the Beekmantown Series at Levis, Quebec. *Bulletins of American Paleontology*, **10**, 1–134.

CUERDA, A. 1979. El género *Amphigraptus* (graptolitina) en el Ordovícico argentino. *Ameghiniana*, **16**, 1–8.

—— CINGOLANI, C. and VARELA, R. 1983. Las graptofaunas de la formación Los Sombreros, Ordovicíco inferior, Sierra del Tontal, Precordillera de San Juan. *Ameghiniana*, **20**, 239–260.

FORTEY, R. A., LANDING, E. and SKEVINGTON, D. 1982. Cambrian-Ordovician boundary sections in the Cow Head Group, western Newfoundland. 95–129. *In* BASSETT, M. G. and DEAN, W. T. (eds). The Cambrian-Ordovician boundary: sections, fossil distributions and correlations. *National Museum of Wales Geological Series*, **3**, National Museum of Wales, Cardiff, 227 pp.

HARRINGTON, H. J. 1938. Sobre las faunas del Ordoviciano Inferior del Norte Argentino. *Revista del Museo de la Plata, New Series*, **1**, *Paleontología*, **4**, 109–289, 14 pls.

—— MOORE, R. C. and STUBBLEFIELD, C. J. 1959. Morphological terms applied to Trilobita. O117–O126. *In* MOORE, R. C. (ed.). *Treatise on invertebrate paleontology, Part O, Arthropoda 1*. Geological Society of America and University of Kansas Press, Boulder, Colorado and Lawrence, Kansas, xix + 560 pp.

HEREDIA, S. 1990. Geología de la cuchilla del cerro Pelado, Precordillera de Mendoza, Argentina. *XI Congreso Geológico Argentino*, **2**, 101–104.

JAEKEL, O. 1909. Über die Agnostiden. *Zeitschrift der Deutsche Geologische Gesellschaft*, **61**, 380–401.

JAGO, J. B. 1987. Idamean (Late Cambrian) trilobites from the Denison Range, south-west Tasmania. *Palaeontology*, **30**, 207–231, pls 24–27.

JELL, P. A., HUGHES, N. C. and BROWN, A. V. 1991. Late Cambrian (post-Idamean) trilobites from the Higgins Creek area, western Tasmania. *Memoirs of the Queensland Museum*, **30**, 455–485.

KOBAYASHI, T. 1936. Cambrian and Lower Ordovician trilobites from northwestern Canada. *Journal of Paleontology*, **10**, 157–167, pl. 21.

—— 1938. Upper Cambrian fossils from British Columbia, with a discussion on the isolated occurrence of the so-called '*Olenus*' beds of Mount Jubilee. *Japanese Journal of Geology and Geography*, **15**, 149–192.

—— 1955. The Ordovician fossils of the McKay Group in British Columbia, western Canada, with a note on the early Ordovician palaeogeography. *Journal of the Faculty of Science, Tokyo University*, [2], **9**, 355–493, pls 1–9.

—— 1966. The Cambro-Ordovician formations and faunas of South Korea, part X. Stratigraphy of the Chosen Group in Korea and south Manchuria and its relation to the Cambro-Ordovician formations of other areas.

Section B. The Chosen Group of North Korea and northern China. *Journal of the Faculty of Science, Tokyo University*, [2], **16**, 209–311.

LERMONTOVA, E. A. 1951. Upper Cambrian trilobites and brachiopods from Boshche-Kul (northeastern Kazakhstan). *Trudy Vsesoyuzniy Nauchno-issledovatelskiy Geologicheskiy Institut* (*VSEGEI*), 49 pp., 6 pls. [In Russian].

LU YAN-HAO 1964. Trilobites. 26–39. *In* ZHU BIAN (ed.). *Handbook of the index fossils of China, Hunan region*. 2nd edn. Geology Press, Beijing, 173 pp., 92 pls. [In Chinese].

—— and LIN HUANLING 1989. The Cambrian trilobites of western Zhejiang. *Palaeontologia Sinica*, **178**, [B] **25**, iv + 1–172 [in Chinese], 173–273 [in English], pls 1–28.

LUDVIGSEN, R., WESTROP, S. R. and KINDLE, C. H. 1989. Sunwaptan (Upper Cambrian) trilobites of the Cow Head Group, western Newfoundland, Canada. *Palaeontographica Canadiana*, **6**, 175 pp., 50 pls.

M'COY, F. 1849. On the classification of some British fossil Crustacea, with notices of new forms in the University collection at Cambridge. *Annals and Magazine of Natural History*, [2], **4**, 161–179, 392–414.

MANCA, N. 1992. El género *Lotagnostus* (Trilobita, Agnostida) en la Formación Santa Rosita (Jujuy, Argentina) y su significado cronologico. *Ameghiniana*, **29**, 45–48.

ÖPIK, A. A. 1963. Early Upper Cambrian fossils from Queensland. *Bulletin of the Bureau of Mineral Resources of Australia*, **64**, 133 pp., 9 pls.

—— 1967. The Mindyallan fauna of North Western Queensland. *Bulletin of the Bureau of Mineral Resources of Australia*, **74**, vol. 1, 1–404, vol. 2, 1–167, 67 pls.

PALMER, A. R. 1962. *Glyptagnostus* and associated trilobites in the United States. *U.S. Geological Survey, Professional Paper*, **374-F**, 49 pp., 6 pls.

—— 1968. Cambrian trilobites from east-central Alaska. *U.S. Geological Survey, Professional Paper*, **559-B**, 115 pp., 13 pls.

PRATT, B. R. 1992. Trilobites of the Marjuman and Steptoean Stages (Upper Cambrian), Rabbitkettle Formation, southern McKenzie Mountains, northwest Canada. *Palaeontographica Canadiana*, **9**, 179 pp., 34 pls.

QIAN YI-YUAN 1986. Trilobites. 255–313, pls 67–82. *In* CHEN JUN-YUAN (ed.). *Aspects of the Cambrian-Ordovician Boundary in Dayangcha, China*. China Prospect Publishing House, Beijing, 410 pp., 98 pls.

RASETTI, F. 1944. Upper Cambrian trilobites from the Levis conglomerate. *Journal of Paleontology*, **18**, 229–258, pls 36–39.

—— 1954. Early Ordovician trilobite faunules from Quebec and Newfoundland. *Journal of Paleontology*, **26**, 797–802, pls 60–61.

—— 1961. Dresbachian and Franconian trilobites of the Conococheague and Frederick Limestones of the central Appalachians. *Journal of Paleontology*, **35**, 104–124, pls 21–25.

RESSER, C. E. 1938. Cambrian System (restricted) of the southern Appalachians. *Geological Society of America, Special Papers*, **15**, 140 pp., 16 pls.

RUSCONI, C. 1948. Apuntes sobre el Triasico y el Ordovício de el Challao, Mendoza. *Revista del Museo de Historia Natural de Mendoza*, **2**, 165–198, pls 1–4.

—— 1950*a*. Trilobitas y otros organismos del Cámbrico de Canota. *Revista del Museo de Historia Natural de Mendoza*, **4**, 71–84.

—— 1950*b*. Nuevas trilobitas y otros organismos del Cámbrico de Canota. *Revista del Museo de Historia Natural de Mendoza*, **4**, 85–94.

—— 1951*a*. Trilobitas cámbricos del Cerro Pelado (Mendoza). *Boletín Paleontológico de Buenos Aires*, **24**, 4 pp.

—— 1951*b*. Más trilobitas cámbricos de San Isidro, Cerro Pelado y Canota. *Revista del Museo de Historia Natural de Mendoza* **5**, 3–30.

—— 1952. Varias especies de trilobitas del Cámbrico de Canota. *Revista del Museo de Historia Natural de Mendoza*, **6**, 5–17.

—— 1953. Nuevos trilobitas cámbricos de la Quebrada de la Cruz. *Boletín Paleontológico de Buenos Aires*, **27**, 8 pp.

—— 1954. Trilobitas cámbricos de la Quebradita Oblicua, Sud Cerro Aspero. *Revista del Museo de Historia Natural de Mendoza*, **7**, 3–60, 4 pls.

—— 1955*a*. Más fósiles cámbricos y ordovicios de San Isidro, Mendoza. *Boletín Paleontológico de Buenos Aires*, **31**, 4 pp.

—— 1955*b*. Nota previa sobre organismos ordovicios y cámbricos de San Isidro, Mendoza. *Boletín Paleontológico de Buenos Aires*, **32**, 4 pp.

—— 1955*c*. Fósiles cámbricos y ordovicios al Oeste de San Isidro, Mendoza. *Revista del Museo de Historia Natural de Mendoza*, **8**, 3–64, 5 pls.

SALTER, J. W. 1864*a*. A monograph of the British trilobites from the Cambrian, Silurian, and Devonian formations. Part 1. *Monograph of the Palaeontographical Society*, **16** (67), 1–80, pls 1–6.

—— 1864*b*. Figures and descriptions illustrative of British organic remains. Decade 11. *Memoirs of the Geological Survey of the United Kingdom*, 64 pp., 9 pls.

SHAW, A. B. 1951. Paleontology of northwestern Vermont, 1. New late Cambrian trilobites. *Journal of Paleontology*, **25**, 97–114, pls 21–24.

SHERGOLD, J. H. 1975. Late Cambrian and early Ordovician trilobites from the Burke River Structural Belt, western Queensland. *Bulletin of the Bureau of Mineral Resources, Australia*, **153**, 251 pp., 58 pls (2 vols).

—— 1977. Classification of the trilobite *Pseudagnostus*. *Palaeontology*, **20**, 69–100, pls 15–16.

—— 1980. Late Cambrian trilobites from the Chatsworth Limestone, western Queensland. *Bulletin of the Bureau of Mineral Resources of Australia*, **186**, 111 pp., 35 pls.

—— 1982. Idamean (Late Cambrian) trilobites, Burke River Structural Belt, western Queensland. *Bulletin of the Bureau of Mineral Resources of Australia*, **187**, 69 pp., 17 pls.

—— (compiler) 1989. Australian Phanerozoic Timescales, 1: Cambrian. Australian Cambrian Biochronology: chart and explanatory notes. *Record of the Bureau of Mineral Resources of Australia*, **1989/31**, 25 pp.

—— 1993. The Iverian Stage (Late Cambrian) and its subdivision in the Burke River Structural Belt, western Queensland. *BMR Journal of Australian Geology and Geophysics*, **13**, 345–358.

—— LAURIE, J. R. and SUN XIAOWEN 1990. Classification and review of the trilobite order Agnostida Salter, 1864: an Australian perspective. *Report of the Bureau of Mineral Resources of Australia*, **266**, 92 pp. 19 figs.

—— and WEBERS, G. F. 1993. Late Dresbachian (Idamean) and other trilobite faunas from the Heritage Range, Ellsworth Mountains, West Antarctica. 125–168, 10 pls. *In* WEBERS, G. F., CRADDOCK, C. and SPLETTSTOESSER, J. F. (eds). Geology and paleontology of the Ellsworth Mountains, West Antarctica. *Memoir of the Geological Society of America*, **170**, 459 pp.

SUN YUN-CHU 1924. Contribution to the Cambrian faunas of China. *Palaeontologia Sinica*, [B], **1**, *Fasc*. **4**, 109 pp., 5 pls.

TROEDSSON, G. T. 1937. On the Cambro-Ordovician faunas of western Quruq Tagh, eastern Tien-shan. *In* Report of the scientific expedition to the northwestern provinces of China under the leadership of Dr Sven Hedin. The Sino-Swedish Expedition Publication 4, V, Invertebrate Palaeontology, 1. *Palaeontologia Sinica, New Series*, [B], **2** (*whole series* **106**), 74 pp., 10 pls.

TULLBERG, S. A. 1880. *Agnostus*-arterna i de Kambriska afflagringarne vid Andrarum. *Sveriges Geologiska Undersökning*, [*Series C*], **42**, 1–37.

WESTROP, S. R. 1986. Trilobites of the Upper Cambrian Sunwaptan Stage, southern Canadian Rocky Mountains, Alberta. *Palaeontographica Canadiana*, **3**, 179 pp., 41 pls.

WHITEHOUSE, F. W. 1936. The Cambrian faunas of northeastern Australia. Part 1. Stratigraphic outline. Part 2. Trilobita (Miomera). *Memoirs of the Queensland Museum*, **11**, 59–112, pls 8–10.

ZHOU ZHI-YI and ZHANG JIN-LIN 1985. Uppermost Cambrian and lowest Ordovician trilobites of North and Northeast China. 63–163, pls 1–29. *In* NANJING INSTITUTE OF GEOLOGY AND PALAEONTOLOGY, ACADEMIA SINICA (compiler). *Stratigraphy and palaeontology of systemic boundaries in China. Cambrian-Ordovician Boundary* 2. Anhui Science and Technology Publishing House, Beijing, 412 pp.

JOHN H. SHERGOLD

Australian Geological Survey Organisation
Post Office Box 378
Canberra, ACT 2601, Australia

OSVALDO BORDONARO

CRICYT, cas. correo 131
5500-Mendoza, Argentina

ELADIO LIÑÁN

Paleontología, Facultad de Ciencias
Universidad de Zaragoza
50009 Zaragoza, Spain

Typescript received 16 October 1993
Revised typescript received 21 March 1994